Asparagus Production

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Asparagus is a valuable crop and one of the earliest of the spring vegetables. Asparagus is a perennial crop and a planting may remain productive for 15 years or more. Spear size and yield will decrease after 12 to 15 years. A planting should produce 2,500 pounds or more per acre of snapped asparagus during its most productive period. Yield is dependent on the amount of food materials that have been stored in the root system as a result of the previous season's fern growth. The longer the period the fern has to grow and the more vigorous the fern, the greater the amount of food materials produced and stored in the root system. Stress from Cercospora blight disease or from overharvesting weakens the plant and reduces the time available for fern growth and energy storage. The planting becomes less vigorous and the spears more spindly each year when asparagus is diseased, overharvested, or stressed in any other manner.

Soils and Site

Asparagus can be grown in many soil types, but deep loam or sandy soils with good surface water and air drainage are best. Good production is also possible in heavier soils. In asparagus production, it is important that the plants develop an extensive storage root system. Therefore, good soil drainage is essential. Asparagus roots can develop to a depth of 10 ft in well-drained soils. It will do well in most soils if the water table does not come within three feet of the surface during the growing season. Asparagus will thrive in soils having a salt content too high for many other crops, but it will not tolerate extreme acidity. Although asparagus will tolerate less than optimum soil conditions, yields are likely to be reduced and the life of the planting will be shortened in these soils. Soils subject to spring wind erosion may need windbreak strips planted to protect tender asparagus spears during harvest.

Soil Preparation

Asparagus occupies the land for many years, so it is very desirable that the soil be made fertile and free of troublesome weeds before the crowns are planted. Since it is more difficult to improve soil after the crowns are planted, soil improving practices must be started at least a year before planting. If soil pH is below 6.0 it should be raised to 6.5 by applying lime according to soil test report recommendations.

Asparagus thrives best in soils well supplied with organic matter. Applications of animal manure or turning under a green crop are desirable practices prior to planting asparagus. Manure application to established plantings is also very beneficial. Specific fertilizer application rates are determined by soil testing. Fifty pounds per acre of phosphate should be placed in the bottom of the planting furrows before setting the crowns.

Variety Selection

There are only a few varieties of asparagus available for planting. Varieties in the past have been various strains of Mary Washington. Hybrids and F2 seed from some new hybrids are available and are recommended for Oklahoma. In field trials they have out produced the Mary Washington variety. "U.C. 157 F1" and "U.C. 157 F2" perform very well under Oklahoma conditions. Several new all-male hybrids developed by Rutgers University have been under test at Bixby, Oklahoma, since 1978 and have produced very high yields at Bixby and in all areas of Oklahoma. Rutgers hybrids include "Jersey Gem", "Greenwich", "Jersey Giant", and "Jersey Queen."

The Rutgers University all-male hybrids out-yield "U.C. 157 F1" by 20 to 50 percent. However, all the Rutgers hybrids tend to fern-out and get loose spear heads at too short a spear height under warm (above 85°F) harvest canditions. This is usually during the last three weeks of May in Oklahoma. To maintain high spear quality, these varieties must be harvested at six to seven inches in length and will not make a 9-inch spear during warm conditions in May.

Growing Asparagus Crowns

For small plantings, it is perhaps best to buy one-year-old crowns from a reliable grower or nurseryman. It may be to the asparagus producer's advantage to grow his own crowns if a large acreage is to be planted.

To grow crowns, high quality seed should be obtained and planted in soil that has never grown asparagus. Soil should be sandy, so crowns can be easily dug and be free from adhering soil. Phosphorous and potassium fertilizer should be applied based on soil test information and worked into the soil prior

to seeding the crown bed. Approximately 30 pounds per acre of nitrogen should be applied preplant and an additional 50 pounds per acre topdressed in early July.

Seed should be planted in early April in rows 2 $^{1}/_{2}$ to 3 feet apart. Eight or nine seeds should be planted per foot of row. One pound of seed should produce crowns for planting one acre of asparagus. A planting depth of one to two inches is needed. Asparagus is slow to germinate requiring two to three weeks for the seedlings to emerge. Crowns are ready to dig after one growing season.

Handling Crowns

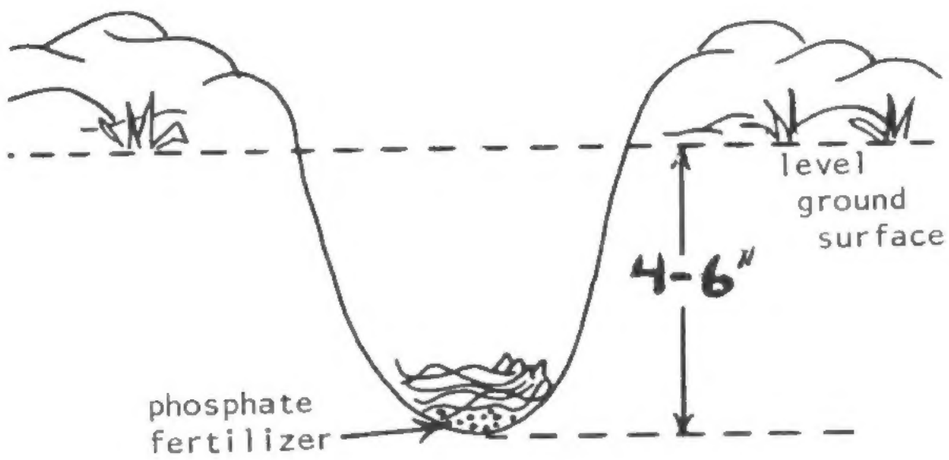
Crowns grown in Oklahoma can be dug in January, February, or early March before bud growth begins and just prior to setting in the field. Old plant tops should be mowed and if necessary removed from the field, so as not to interfere with digging the crowns. A peanut or potato digger can be used to lift the asparagus crowns from the nursery row. Care should be taken not to injure the crowns during digging. Crowns should be planted as soon as possible after digging.

When it is necessary to hold the dug crowns, before setting them in the field, they should be stored in a moderately dry, protected place at a temperature near 40°F. Crowns can become overheated if they are stored in a large pile. Extreme drying of the crowns should be avoided. Crowns will freeze at 32°F and severe injury, or even complete loss, can occur if the crowns are allowed to freeze. Frozen crowns become mushy when thawed and must be discarded.

Setting the Crowns

Before planting, separate the individual crowns that are tangled and grown together. Having the crowns separated before going to the field speeds the planting process. While separating the crowns sort out the very small crowns, since they will not compete if planted between two large crowns. Small crowns will produce satisfactorily if planted together in the same row.

Hand place the crowns in the bottom of planting furrows four to six inches deep. Workers can carry crowns in buckets or baskets for planting small areas. For larger acreages crowns can be loaded on a trailer which is slowly pulled down the planting furrows. Workers sitting on the sides and back of the trailer drop crowns into the newly opened furrows. It makes no difference if crowns are planted upright or upside down.



Proper crown planting depth with phosphate fertilizer applied in the bottom of the furrow before planting the crowns.

The planting furrows should be opened with a middlebuster plow just ahead of planting to provide a loose, moist plant bed. A furrow opener equipped with a fertilizer hopper and a conducting tube to place the phosphate fertilizer in the bottom of the furrow is ideal, but a small spreader following the furrow opener will suffice. Space the rows five to six feet apart. Space plants 12 to 15 inches apart in the row. This requires 6,000 to 9,000 crowns per acre depending on spacing in and between rows.

Tests at Bixby, Oklahoma, indicate planting 9,000 crowns per acre will out yield 6,000 crowns per acre by a small amount for one or two seasons. By the third harvest season, yields are equal with 6,000 and 9,000 crowns per acre. For vigorous and expensive all-male hybrids, planting 6,000 crowns per acre is recommended. The distance between rows may be determined by the harvesting and field equipment to be used. A large percentage of small diameter spears will be produced if crowns are set too close together. In the more humid eastern area of Oklahoma row spacing of six feet may reduce the Cercospora blight disease problem. Also, running rows north and south will promote faster drying of the asparagus fern and help reduce Cercospora blight.

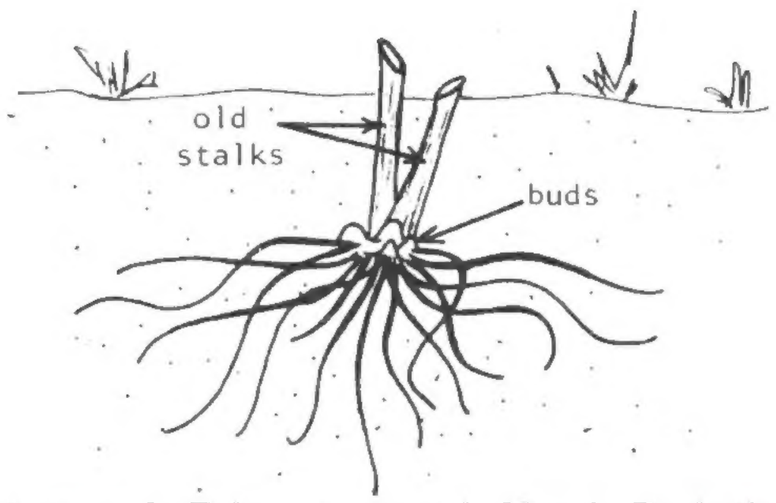
Cover the crowns with two to three inches of soil immediately after planting. Work more soil into the furrow as growth progresses or as needed to cover emerging weeds until the furrow is filled, usually by the middle of June. No herbicides are available for use on new asparagus plantings.

Transplant versus Crowns

In addition to crowns, two other methods are available for establishing asparagus. The first is direct seeding and is not recommended. Using greenhouse-grown, 10-week-old transplants is increasing in popularity. Expensive hybrid seed will plant double the area or about 2 acres/pound when transplants are grown. One disadvantage of transplants compared to crowns is the very low yield one year from planting. The major problem with transplants in Oklahoma is due to heavy spring and early summer rainfall causing the four-inch deep planting furrows to erode which destroys the small seedlings. The problem is greater on rolling land. Cost of asparagus transplants is usually similar or less than the cost of crowns.

Fertilizing the First Year

Have the soil which is to be planted to asparagus tested in the late fall or early spring. The amount of fertilizer to be plowed under in the spring before setting the crowns should be determined from soil test results. Along with the recommended phosphate and potash fertilizer, apply 50 pounds per acre of nitrogen. Plowing the fertilizer under puts it at the best depth for asparagus crowns. In addition to the amount of fertilizer recommended above, phosphate fertilizer should be applied down the furrow before setting crowns (250 pounds per acre 0-20-0 or 100 pounds of 0-46-0). Newly set crowns should be sidedressed with 30 pounds per acre nitrogen at the first cultivation.



Dormant crown in February or early March. Buds that develop into spears are beginning to elongate beside dead plant stems from the previous growing season.

Fertilizing Established Plantings

The objective during the first two years after planting crowns is to develop maximum fern growth in order to build an extensive storage root system. Any practice that interferes with this objective can have a detrimental effect on yield and may shorten the potential life of the asparagus planting.

Before the spring discing the second year (one year from planting) broadcast 70 pounds per acre nitrogen. Each year after the second year, topdress 70 pounds per acre nitrogen about two weeks before the end of the harvest season (about May 15). At five-year intervals conduct a soil test, and if recommended, apply needed lime, phosphate, and potash fertilizers in addition to the annual nitrogen application. Animal manure is excellent fertilizer for asparagus where available. See OSU Extension Fact Sheet F-6000 Fertilizing Commercial Vegetables—for complete information on fertilization rates based on soil test information.

Irrigation

Irrigation is important to relieve drought stress, particularly during the first two seasons after crown planting. Dry weather during the cutting season or late in the fern growing season (October) will have little effect on yield. An extended dry period early in the development of the fern after the cutting season is undesirable and may reduce yield the following year.

Asparagus is very deep rooted and draws water from a large volume of soil. This allows the crop to withstand considerable dry weather. Deep rooting also permits longer intervals between irrigation applications than in other irrigated crops. Successful asparagus production in western areas of the state requires irrigation for high yields.

Weed Control

For information on controlling weeds in established asparagus fields or crown production nurseries see OSU Extension Fact Sheet F-6008 Weed Control in Vegetables.

Insects

Cutworms. Among early season pests, cutworms, especially the variegated and black cutworm, cause sporadic, but occasionally severe damage. The adults of cutworms are robust moths with dark-colored forewings and light colored hindwings. Larvae are greasy-looking dark-colored caterpillars that feed at night. Young cutworms climb plants and feed on spears and ferns of asparagus. Older larvae are active at night, feeding on spears at the soil surface, cutting them at ground level. Depending on the species, early spring damage may be caused by larvae that have overwintered. Moths are active at night and lay eggs on leaves or stems close to the soil surface soon after plants emerge. Damage by cutworms is characterized by spears being cut partially or completely at the soil surface.

Management. After spear emergence, check for severed spears or spears that have begun to curl from partial severing. Cutworms are more easily detected at dawn or at night with a flashlight. Damaged plants often occur in a sequence of four or five within a row. Areas that have had a dense stand of weeds often have high populations. Baits are more effective when other food is limited, so check for cutworms and apply bait to the field before the spears emerge, especially where cutworms have caused damage before. If an insecticide spray is used, effectiveness is increased by banding the insecticide at the base of the plant, preferably at dusk or shortly before.

Asparagus Beetles. Common asparagus beetles appear early to mid-April and feed on spear tips. Adult beetles are easily recognized by their bright, shiny coloration; they have bluish-black wing covers with yellow squared spots and red outer margins. Eggs are dark brown to black, oblong shaped, and are laid in a comb-like pattern on the ferns and spears. When adults lay eggs on the spears, they sometimes become unmarketable because it is impossible to wash the eggs off. Larvae are dark gray with black heads and become plump, humpbacked, and sluggish as they mature. Pupae are yellow in color and develop in a silken cocoon in the soil before emerging as adults. The life cycle takes about 3 to 4 weeks during summer temperatures and up to 8 weeks in the spring or fall. In the summer, it requires 3 to 8 days for egg hatch, 10 to 14 days for larval development and 5 to 10 days for pupal development. Both adults and larvae eat shoots and leaves, but are particularly devastating when they chew the tips of spears, causing them to scar and turn brown. In addition to their feeding damage, larvae also secrete a dark fluid that stains the plants.

Management. No economic threshold have been established in Oklahoma upon which insecticide sprays can be timed. In general, if beetles are present in early spring when spears can be damaged, sprays should be applied to avert any damage to the marketed product. Later in the year, some damage can be tolerated to the ferns, but if significant amount of defoliation appears imminent, an insecticide should be applied. Many beneficial insects reduce the numbers of asparagus beetles through their predation and parasitism of eggs and larvae, including ladybeetles and other predaceous beetles, as well as certain tiny wasps.

Aphids. Aphids are potential pests of asparagus as ferns are growing. Aphids extract plant juices feeding with their needle-like mouthparts, and can ultimately result in stunted and deformed fern growth. Aphids are tiny soft-bodied insects that have both winged and nonwinged forms. They are usually pale green to gray in color and can be recognized by the their "tailpipe"- like appendages (cornicles) visible on their abdomen under slight magnification. Natural control factors, such as predators, parasites, and heavy rainfall, most often prevent aphid numbers from increasing to damaging levels. If outbreaks occur, control can usually be accomplished with insecticides.

Grasshoppers. Several species of grasshoppers may become pests on an occasional basis, especially in late summer when surrounding vegetation begins to dry. Severe defoliation may occur if grasshoppers continue to feed in large numbers. Sustained defoliation may result in decreased yield the following spring or potentially loss of plant stand. Grasshoppers are sometimes difficult to control because of their mobility. Baits, perimeter sprays, or foliage insecticide treatments may be necessary if grasshoppers appear in large numbers.

For information on chemical insect control, refer to the latest version of the OSU Extension Agent's Handbook of Insect, Plant Disease, and Weed Control (E-832).

Diseases

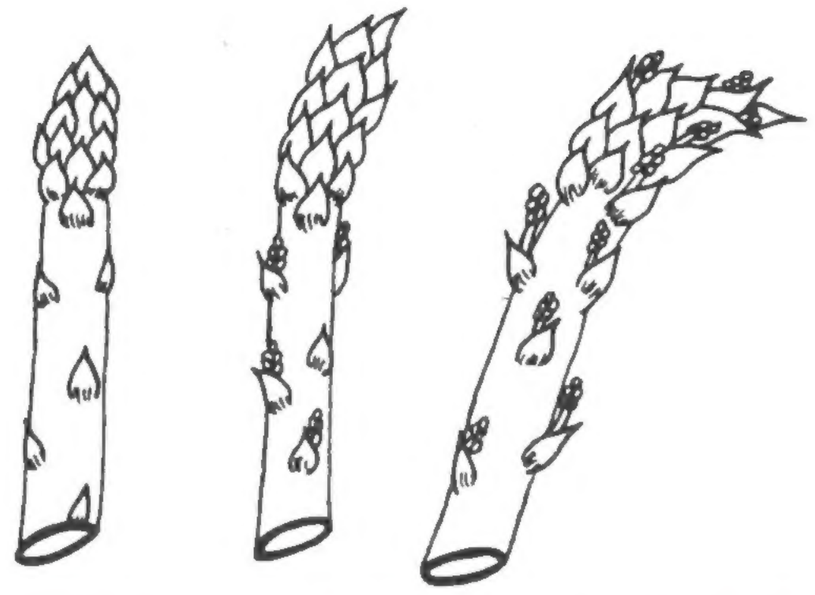
There are four root, crown, and foliar fungal diseases of economic importance to Oklahoma asparagus production. They include: Fusarium crown and root rot (*Fusarium moniliforme*), Fusarium wilt (*F. oxysporum* f. sp. *asparagi*), needleblight (*Cercospora asparagi*), Phytophthora crown and spear rot (*Phytophthora megasperma* var. *sojae* and some other *Phytophthora* spp.), and rust (*Puccinia asparagi*). Fusarium crown and root rot, Fusarium wilt, and Phytophthora crown and spear rot usually are introduced into asparagus fields on planting material. Thus, planting disease-free crowns and transplants is the most efficient method of control. Needleblight, often misdiagnosed as rust, is the most common and destructive foliar disease of asparagus in Oklahoma when rainfall and extended dew periods persist during June and July. For detailed information concerning asparagus diseases and their control, consult OSU Extension Fact Sheet F-7646 Diseases of Asparagus in Oklahoma, and the current edition of the OSU Extension Agents' Handbook of Insect, Plant Disease, and Weed Control (E-832).

Preparation for Harvest

In late February or early March the dead fern growth from the previous season must be chopped level with the soil surface with a brushhog mower. A shallow discing can follow mowing. If lime, phosphorous, or potassium fertilizer is needed, it should be applied prior to discing. Even if a no-tillage system is planned, discing is usually necessary to level the field the spring after the crowns are set in the field. A drag behind the disc leaves a level soil surface for herbicide application and harvesting operations. Do not allow the disc to get deeper than needed for controlling weeds and soil leveling or emerging spears or even crowns may be injured. A no-tillage production system works very well for asparagus and is recommended to minimize soil erosion.

Harvesting

Asparagus cannot be harvested the year of setting crowns, since it must be allowed to grow and develop a strong storage root system. With vigorous varieties, high quality crowns, good management, and Oklahoma's long growing season a brief harvest period of about four weeks is possible the first year after crown planting and about seven weeks the second year after planting. About 500 pounds/acre of spear production is possible the first year after crown planting. Spear diameter will be smaller and possibly more difficult to market than the larger



Spears should be harvested when the heads are tight and before they "fern-out." Left spear above is of high quality; middle spear is of lower quality, and right spear is "ferning-out" and is very low in quality.

spears produced after the first harvest season. In succeeding years the harvest season can be extended to eight to nine weeks. Anytime that the spear diameter becomes less than three-eighths inch in diameter, harvesting should be discontinued. Asparagus spears emerge continually, but there are flushes of spear emergence. Usually there are three to four flushes during the cutting season. Normally, harvest will be during April, May, and possibly into early June in northern Oklahoma. In southern Oklahoma harvest will begin 7 to 10 days earlier than in northern areas. Approximately two-thirds of the production will usually be harvested during the first one-half of the harvest season.

Asparagus spears can be cut or snapped when they are 6 to 10 inches tall. Harvesting in the morning when the spears are cooler and more easily snapped-off is recommended. This also improves quality. The snapping method is faster and less expensive than cutting at or below the soil surface with a long-handled asparagus knife. Always harvest spears when the heads are tight before the tips start to "fern out." In the early cool part of the harvest season, spears can grow 10 to 12 inches and the heads will remain tight. Fiber content will be low in the base of the spears. In warmer weather spears will "fern-out" at a shorter height and fiber will develop faster. Therefore, spears must be harvested when shorter during warmer weather. Markets can dictate spear length with large wholesale markets requiring 9-inch spears. Other markets may accept shorter spears or asparagus packs with variable spear lengths.

It will be necessary to harvest daily or more often when the weather is warm. During cool periods, it may not be necessary to harvest more than two or three times a week. Make sure that the field is cut or snapped clean with each harvest. Any ferns that are allowed to grow can harbor diseases and insects. This growth will also delay the emergence of new spears.

If more than two or three acres of asparagus are grown, it may be worthwhile to use a harvest aid machine to carry the workers for snapping asparagus. Approximately two-person hours of labor are needed to pick one acre of asparagus at each harvest. Harvest aids may reduce the labor requirement by 10 to 15 percent and workers are usually more content to ride a harvest aid than to walk and stoop to pick asparagus.

Several mechanical asparagus harvesters have been developed and are on the market. Most available harvesters are nonselective and reduce yield 35 to 50 percent compared to hand picking. Thirty to forty acres of asparagus are required to justify most harvesting machines and the cleaning equipment needed to clean machine-harvested asparagus before packing and marketing.

Asparagus Harvesting Strategy

In harvesting asparagus, it is important to maximize yield and profit and to ensure high quality. Poor harvest timing or strategy can reduce quality, and yield loss can be half or more of the total crop. For high quality asparagus must be cut or snapped while the head of the spear is tight and the buds under the scale below the head of the spear have not elongated. If the head of the spear is loose (ferned-out) this indicates poor quality and is a sure sign that excessive fiber (toughness) has developed in the base of the spear. Loose-headed and fibrous asparagus is objectionable to wholesale buyers and consumers and must be discarded in the field or packing sheds.

Established asparagus produces 100,000 to 200,000 spears per acre over a normal harvest season. If all spears are harvested by snapping or cutting to provide the maximum marketable length of nine inches, the greatest possible weight will be obtained. Year to year and varietal yield differences in an established field are due mainly to differences in number of spears produced per acre. Variety, depth of planting, weather, and the general health and vigor of the asparagus plant affects spear number and diameter. Harvesting all spears to obtain maximum marketable length, but before ferning-out is not economical. During warm weather this would require harvesting a field several times each day. Labor availability and cost would usually prohibit multiple daily harvesting on commercial scale production. Harvesting a small planting in both morning and afternoon during warm weather does increase yield and is practiced by some producers. In actual practice, with hired labor, asparagus is usually harvested every second or third day during the earlier and cooler part of the harvest season, but must be harvested every day during warm weather beginning in late April and throughout May in Oklahoma.

To maximize yield and profit, a decision must be made before each harvest concerning the minimum height spear that will be harvested. This could be anywhere from five to eight inches. This decision should be based on several factors. The most important is the planned time period between this harvest and the next harvest. Spear elongation rate expected after this harvest and before the next harvest must also be considered. Experience from the past few harvests is also very valuable information for making a decision.

Factors besides air temperature that influence spear elongation rate are relative humidity and to a much less extent sunlight, wind, and soil temperature and moisture. Spears elongate most rapidly under warm air and soil temperature, moist soil, high relative humidity, cloudy sky, and no wind. Varieties differ little in spear elongation rate when they are under similar environmental conditions in the field. Varieties do differ in the spear height when ferning-out occurs and when fiber begins to develop in the base of the spear. Under similar growing conditions the old standard Mary Washington variety and the new all-male hybrids Jersey Giant, Greenwich, and Jersey Gem fern-out at a much shorter spear height than the varieties U.C. 157 F1 or F2.

Harvesting decision examples - Example 1: The picking crew is about to begin harvesting and the next planned harvest will be in 24 hours. The weather forecast is for cool and dry conditions. What instructions should be given to the pickers concerning the minimum height spear selected for harvest today? In this situation only spears that are longer than 7 inches after harvesting should be picked. All shorter spears should be left for harvesting 24 hours later. Example 2: It is Saturday morning in the middle of May. The weather forecast for Saturday and Sunday is for very warm, humid, and cloudy weather with a high probability of rain showers. No labor is available to harvest on Sunday, so the next harvest is nearly 48 hours away. Under these conditions even spears that are very short (4" to 5") need to be harvested on Saturday. If the 4 to 5-inch spears are not harvested, they will be 12 to 15-inch spears that have ferned-out by Monday morning. With the weekend situation described above it would be best to harvest as late as possible on Saturday afternoon or evening and as early as possible on Monday morning to reduce the time to the next harvest and amount of ferned-out cull asparagus. Even though the ferned-out spears are not marketable, they must be cut or snapped to maintain production and to deny insects and diseases a site to get started.

Asparagus spears that are damaged at the tip by cutworms feeding or careless workers grown crooked and unmarketable.

Handling Asparagus after Harvest

Asparagus gives off heat, loses moisture, and can be lost if not handled properly after harvest. The rate of post-harvest deterioration is influenced by handling practices, sanitation, relative humidity, and temperature. Loss of quality begins at harvest and exposure to high temperatures from 90° to 100°F for even a few hours result in tremendous quality loss. On warms days, use cold water baths in packing sheds to remove some of the field heat. This will keep the asparagus fresh and precools the crop to an intermediate level. Handle carefully since bruising increases respiration, damages the natural moisture barrier, and provides points of entry for rot organisms.

Once packed, asparagus should be rapidly cooled to 40°F by hydrocooling and maintained at that temperature or cooler. Good hydrocooling requires that adequate ice be used to keep the coolant level temperature at 36°F, and the coolant water

should be chlorinated at approximately 125 part per million to protect the asparagus from rot organisms such as bacterial soft rot and gray mold rot. If hydrocooling is not available, then cold rooms will lower asparagus temperature. However, spear temperature in cold rooms is lowered much too slowly and asparagus quality and shelf-life will be reduced. For best quality, asparagus to be held less than 10 days should be kept at 32° to 34°F. If greater than 10 days and up to three weeks the temperature should be 36°F to avoid chilling injury due to prolonged low temperature. Relative humidity should be 90 to 95 percent and cold rooms need good air circulation. To avoid chilling damage, never allow ice to be in direct contact with asparagus.

When displayed for retail sale, asparagus should be kept near 32°F. Sprinkling periodically with cold water will help preserve quality longer. Displaying asparagus with butts standing in trays of ice water helps maintain quality.

Marketing

Several fresh markets are available for asparagus. Near population centers asparagus can be picked and sold directly to consumers. Asparagus is one of the more difficult vegetables to market by "U-pick" methods. Considerable customer orientation is required for proper harvesting. If customers are allowed to walk on the asparagus rows or snap very short spears, crop damage and yield loss can be significant. Losses are partially off-set by reduced harvest labor costs. Spears not harvested by U-pick customers grow tall and fibrous and must be destroyed. Beds in a U-pick marketing system must be snapped clean regularly to avoid insect and disease problems and to keep the bed producing new spears.

Potential wholesale markets include roadside stands, independent stores, chain stores, vegetable repackers, or terminal vegetable markets. Each of these potential markets will have specific trimming, grading, packing, and handling requirements. When obtaining a market, buyer requirements for trimming, grading, packing, and handling should be understood in detail before harvest and delivery.

Costs

The major expense in asparagus production is the initial cost to establish the crop. Major planting cash expenses are for asparagus crowns or transplants and fertilizer. Other major costs are labor related. Cost of maintaining the crop after establishment is less than costs incurred in producing most other vegetable crops. Harvesting costs are somewhat dependent upon yield, but will generally be 25 cents per pound for hand snapping and somewhat less if nonselective machine cutting is used. Hand snapping or cutting is more costly than nonselective machine cutting but yields are enough higher to more than offset the hand harvest cost.

Estimated Cost to Establish Asparagus (first year)

Input	Cost per acre
Soil preparation for planting	$ 40
Fertilizer (N,P,K)	60
Asparagus crowns 8,000 @ $45 (purchased)	*360
Planting labor	80
Cultivating, hand hoeing	70
Fungicides, insecticides	50
Irrigation (Western Oklahoma)	60
Other costs (interest, labor, land, machinery)	280
Total	$1,000

*Add $330 if planting all-male hybrid crowns or transplants of varieties such as Jersey Gem or Jersey Giant. This is based on planting 6,000/acre at a cost of $115 per 1,000 crowns or transplants.

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